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China's Plans for Modernizing Telecommunications

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A Research Paper

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*EA 85-10045
March 1985*

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China's Plans for Modernizing Telecommunications

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A Research Paper

This paper was prepared by [redacted]
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China's Plans for Modernizing Telecommunications

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Summary

*Information available
as of 1 February 1985
was used in this report.*

Concern for economic modernization as well as more traditional concern for military and political control have prompted Beijing to accelerate its efforts to modernize Chinese telecommunications. China's telecommunications networks—a patchwork of largely outdated equipment—provide notoriously poor telephone service, meet only a few of China's data communications needs, and offer TV broadcasting services to no more than half of the landmass. Shortages of quality components, inadequate technical knowledge, and lack of test and production equipment have limited China's attempts to produce domestically the equipment required to meet the nation's growing communications needs.

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Foreign manufacturers are playing a major role in China's telecommunications modernization as these problems have forced Beijing to look abroad for advanced equipment and production know-how. China already has acquired a considerable amount of foreign telecommunications equipment and is now stressing acquisition of manufacturing technology. Key purchases under negotiation are direct broadcast satellites and related technology, fiber optics manufacturing technology, and advanced switching systems. Firms and governments in a number of developed countries offer technical exchanges, training programs, and financial assistance.

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In our view, COCOM has the potential to be a major barrier to China's modernization plans, especially because of China's emphasis on acquiring production technology. The participation of the military in Chinese telecommunications modernization will make sales of production technology to China particularly controversial. Equipment sales may be more readily approved than deals for production technology, but the need for COCOM approval will slow the acquisition process.

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Other barriers to telecommunications modernization include:

- The profusion of actors involved in Chinese telecommunications obscures priorities, complicates planning, hinders the technology acquisition process, and creates competition for funds.
- Funding problems have delayed even high-priority projects at the local level. China recently accepted some foreign financial assistance from Canada, Belgium, and Japan for communications projects and may be more willing to do so in the future.
- Planning and management weaknesses, which have hampered communications developments in the past, will probably continue despite China's attempts to improve the expertise of its telecommunications personnel.

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As a result of these impediments, we believe progress in communications modernization will be slower than China anticipates, even for key projects such as communications support for energy development and improvement of telephone and data communications services in key cities. One exception is likely to be the development of a fiber optics network, which has the weight of centralized planning and military oversight behind it. Overall, telecommunication services and operations will probably remain limited and inefficient for the near future. []

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Thus, despite some improvements, we believe Chinese telecommunications will fall short of the needs of China's economic modernization. Problems in communications expansion will continue to hinder business and industrial management. Any further delay in procuring direct broadcast satellites and developing the necessary ground network also will postpone China's plans to use this medium for transmitting educational broadcast services as well as for propaganda and political control. Economic and social development in China's more remote regions will continue to suffer from limited communications services. []

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A secondary benefit of China's efforts to acquire telecommunications equipment and technology, however, is its contribution to development of the electronic components and computer industries. China has acquired production technology for sophisticated integrated circuits as part of one switching system purchase, for example, and is insisting on transfer of component technology in other negotiations for advanced computer-controlled switching systems. []

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The military, as a priority user of foreign technology and of China's communications network, will benefit in particular from active involvement in the fiber optics and satellite projects. Improvements in high-speed switching capabilities will enhance China's command and control communications, and the acquisition of fiber optics technology and encryption devices will improve communications security. In addition, we believe that much of the advanced integrated circuit technology now being acquired legally will probably be diverted from telecommunications industries to support advanced weapons development. []

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China's telecommunications modernization plans offer the United States opportunities to contribute to the development of a critical portion of China's infrastructure through both government and private technical exchanges and cooperation. They also offer US firms opportunities for

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equipment and technology sales, although US firms face serious competition in the Chinese market. European and Japanese companies [redacted]

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[redacted] are offering concessionary financing and discounted prices and, in some cases, are promising more advanced technology than US suppliers. [redacted]

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At the same time, we believe the Chinese communications modernization effort will probably increase tensions within COCOM and perhaps in US-Chinese relations, particularly regarding assurances that imported equipment and technology will be used in nonstrategic applications. The United States will face increased pressure from China as well as from some COCOM members to liberalize export controls for telecommunications equipment and technology. [redacted]

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US manufacturers may also face competition from China in Third World markets in the future. Through cooperation with foreign firms, China hopes to expand the types and amounts of its telecommunications exports. Although we believe China will be unable to offer products equivalent to the most advanced Western or Japanese products, it may be able to offer products adequate for Third World users. [redacted]

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China's Plans for Modernizing Telecommunications

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Introduction

Although Beijing has long viewed telecommunications as important for maintaining political control and national security, Beijing's economic modernization program has given added impetus to China's efforts to improve communications services. In 1981, as China's attempt to reform its economy quickened, Vice Premier Yao Yilin announced that telecommunications was one of China's highest priorities for development. Party Secretary Hu Yaobang reaffirmed this in 1983 at the 12th National People's Congress, when he characterized the buildup of telecommunications facilities as second in importance only to energy development in China's modernization program.

Efforts to improve the system subsequently accelerated, and some achievements have been made. Most of China's plans, however, are only now being implemented. This paper assesses Beijing's plans for modernizing telecommunications, prospects for implementing these plans, and implications for China's modernization.

The Telecommunications Bottleneck

China's need for a high-capacity national communications system to carry voice, data, telex, television, and facsimile traffic has been apparent for over a decade. Minimal improvements in Chinese communications during the 1960s and 1970s were outdistanced by rapidly growing government, military, and commercial telecommunications needs. The network relies on a patchwork of largely outdated equipment—some from the 1930s and 1940s—which is unable to handle today's increased traffic volumes and sophisticated communications requirements. The phone system is notoriously bad, TV broadcasting services reach no more than 50 percent of the landmass, and all but a few data communications needs are unmet.

Reach Out and Touch Someone—Maybe

Phone service in China is oriented toward serving government and business needs rather than private individuals, although private lines are available to selected ranking military and government officials. Even so, the number of phones in China is extremely low. Telephone service density (the number of phone lines per 100 people) is 0.40. By comparison the average developing country ratio is 1 to 100 while the world average is 10 to 100. According to a 1983 survey, the number of phones in all of China is far less than the number in Hong Kong. Shanghai has approximately one phone for every 45 people—the best such ratio in China. Poor service—including long waiting lists for new phone installation, faint or interrupted conversations, and long delays in making long-distance calls—is a frequent complaint.

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Beijing's attempts to promote greater economic efficiency and productivity are hampered by inadequate communications services. Improved communications are needed to facilitate the flow of information between ministerial and provincial organizations, between research institutes and factories, and between factories, suppliers, and customers. In addition, the greater foreign presence in China since 1978 has created a massive demand for more efficient, reliable, and specialized communications links with the outside world. For these links, China needs compatible systems in order to interface with Western communications systems. (For further discussion of China's current services and plans to modernize, see appendix A.)

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To remedy these shortcomings, the Chinese Ministry of Posts and Telecommunications (MPT)—China's primary communications service organization—intends to increase the pace of development in the telecommunications sector to catch up with and then exceed the rate of development in other sectors. The MPT's ambitious plans for improving the common carrier network in China focus on upgrading and expanding the capabilities of the network as a whole, improving the telephone system in key cities, and expanding the network within the provinces. Establishing a telecommunications and broadcast satellite system to support both economic and educational needs is a high priority. [REDACTED]

capabilities and is experiencing operational problems. (Appendix B provides further detail on Chinese technical capabilities and needs.) These problems illustrate how Chinese telecommunications research and development is hampered by limited availability of or poor quality components, inadequate technical knowledge, lack of test equipment, duplication of effort and wasted resources, long leadtimes to bring research projects to production, manual production lines, and inadequate incentives for quality production. [REDACTED]

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Beijing now recognizes that it will have to look abroad for the equipment and technology needed to produce sophisticated telecommunications systems in volume quantity. China is willing to purchase equipment for a few high-priority needs. In keeping with its basic policy on technology imports, however, its main emphasis is on acquiring production technology in order to improve domestic capabilities and achieve subsequent self-reliance. China seeks as much training as possible to enhance its ability to use the equipment and technology purchased. In a number of cases, China has sought manufacturing capabilities which probably would exceed domestic demand, indicating a possible intention to produce for export eventually. (Chinese efforts to acquire foreign equipment and technology are discussed in appendix C.) [REDACTED]

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The Foreign Role

China already has acquired advanced telecommunications equipment—switching systems, satellite ground stations, and some terminal and test equipment—and foreign suppliers are eager to conclude further sales of both equipment and technology. Key purchases under negotiation are for direct broadcast satellites and related technology, fiber optics manufacturing technology, advanced switching systems, and pulse code modulation transmission technology. Beijing has also expressed some interest in advanced cable, microwave, and troposcatter systems. Major suppliers of telecommunications equipment and technology to China include Japan, Hong Kong, the United States, France, West Germany, and Sweden (see table 1). [REDACTED]

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25X1**Strategy**

China has managed to produce and install a large amount of telecommunications equipment in the 35 years since the Communist takeover. In general, however, this equipment—mostly of foreign design or Chinese adaptations of early Western or Japanese products—performs adequately but at lower capacities than equipment currently available in the West. China's first communications satellite, launched in April 1984, is a significant accomplishment for Beijing, but [REDACTED] the satellite has limited

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Table 1
Chinese Telecommunications Imports

Thousand US \$

	1978	1979	1980	1981	1982	1983
Total	30,984	195,981	366,781	530,925	285,018	NA
Hong Kong	331	30,441	121,582	256,543	131,204	170,079
Japan	6,381	83,493	139,543	176,331	92,021	138,451
United States	1,125	6,379	7,436	15,665	10,507	15,564
West Germany	1,065	3,256	2,483	4,721	4,595	8,604
France	7,716	15,080	14,325	6,650	7,591	14,316
United Kingdom	4,023	2,603	2,828	1,840	3,354	7,594
Canada	314	48	119	192	823	4
Sweden	2	689	301	279	1,512	3,586
Belgium/Luxembourg	1,194	406	714	643	64	147
Switzerland	547	2,470	180	622	408	1,214
Denmark	206	245	510	434	293	220
Norway	2	10	1,522	16	10	362

Competition among foreign suppliers for telecommunications sales to China is strong. China's willingness to buy foreign telecommunications equipment and technology raised foreign manufacturers' awareness of the potentially lucrative Chinese market at the same time a more relaxed Western attitude toward China appeared to ease the way for sales to Beijing. China's intention to limit the total number of suppliers of key equipment in order to ensure systems compatibility has further heightened the competition. At the same time, China plays foreign suppliers off against one another to obtain the best possible terms and prices. []

The governments of foreign telecommunications manufacturers have been more active in sales negotiations over the past few years, particularly in telephone switching negotiations for which competition is particularly fierce. The Belgian Government granted two soft loans valued at \$12 million as part of the sale of advanced switching equipment and technology to China and retains part ownership in a joint-venture company established as part of the sale. []

China uses extensive international cooperation and foreign training for Chinese personnel as additional mechanisms for acquiring advanced technical information and upgrading its telecommunications systems. China has ongoing or proposed government-to-government cooperation programs for assistance in telecommunications and space with West Germany, the United States, Italy, France, the United Kingdom, and Brazil. Cooperation with Japan includes public and private cooperative programs as well as Japanese Government financial credits. The Chinese have contracted with foreign firms for specific telecommunications guidance and services; a US firm recently helped draft China's request for proposal for direct broadcast satellites and will help evaluate the proposals. Chinese involvement in activities of the International Telecommunications Union (ITU) is an additional avenue for information exchange and assistance. []

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Barriers to Telecommunications Modernization

Successful implementation of the Chinese plans for telecommunications modernization depends on China's ability to overcome both external and internal barriers. []

COCOM

COCOM could be a major barrier to Chinese telecommunications modernization efforts, particularly for the transfer of production technology for high-priority areas such as fiber optics and broadcast satellites. Military participation in China's telecommunications systems raises concern about the military implications of a communications buildup, despite Beijing's insistence on the basically civilian nature of its plans. Equipment purchases generally will be less controversial, but the need for COCOM approval slows the acquisition process. As a leader in COCOM, the United States faces continuing pressure from China, as well as from other COCOM members, to liberalize export controls []

Broadcast Satellites. Beijing has not selected a supplier for direct broadcast satellites and production technology, but already is lobbying hard for a blanket approval of the technology transfer. Beijing is using its contracts with European firms to pressure the United States to relax its guidelines for the transfer of broadcast satellite technology. Chinese officials have told US officials and firms that Europeans have promised a full and open exchange of technology. West German officials already have proposed that satellites for export to China be given flexible treatment in COCOM. []

Switching. COCOM approved a Belgian sale of advanced switching equipment and production technology in 1983 after agreeing on a phased transfer of technology. Aspects of the sale are under continuing COCOM review. COCOM claimed not to be setting a precedent, but the decision may have had that effect nonetheless. Increased switching capacity and upgraded switching technology are essential for expanding China's communications services. COCOM denial of switching production technology would force China to buy additional switching systems until domestic production increases, a costly alternative since switching systems are the most expensive single element of a communications network. []

Fiber Optics. COCOM is about to approve a Belgian sale of fiber optic equipment to China after lengthy and contentious discussions. Sales of production technology promise to be even more controversial. The United States already has objected in COCOM to a proposed UK sale of an optical fiber preform manufacturing system. France and Belgium may also be interested in a more liberal policy of selling fiber optics technology to China. []

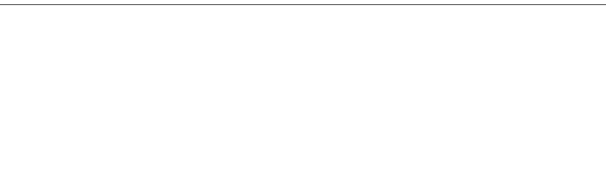
If COCOM suppliers were to deny China access to fiber optics manufacturing technology, we believe Beijing could probably find ways to acquire this technology covertly. []

China has acquired a substantial amount of fiber optic technology and equipment in the past [] Western companies by circumventing COCOM controls. Most of this equipment has been for use in China's R&D effort and primarily involves test instrumentation that can be acquired easily through third country intermediaries. []

If China is unable to purchase fiber optic production technology and broadcast satellites, implementation of its planned networks will be delayed. Should China complete current negotiations with fiber optics suppliers by early 1985, it could have a fiber optic trunk network in operation by 1991. Covert acquisition of large-scale fiber optic manufacturing technology or a Chinese effort to develop it indigenously would delay completion of a network until 1995 or later. Failure to acquire broadcast satellite production technology² would probably delay Chinese manufacture of these sophisticated satellites by at least 10 years. []

Bureaucratic Confusion

Other major problems confronting China's modernization efforts stem from the bureaucratic confusion surrounding Chinese telecommunications. As the inset shows, a number of ministries—each with subordinate research institutes, factories, and trading organizations—are involved in telecommunications. This



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Principal Players in Chinese Telecommunications

Ministry of Posts and Telecommunications (MPT). Sets policy and standards for the common carrier network; establishes tariffs; owns and operates public telecommunications facilities; operates research and production facilities; major purchaser of foreign equipment and technology; leases dedicated lines to other ministries. []

Ministry of Electronics Industry (MEI). Develops and manufactures telecommunications equipment for the common carrier network, industrial users, and the military. Tries to ensure the most technology transfer in agreements with foreign suppliers. []

Dedicated Systems Users

The Military. Has its own communications system and also uses the common carrier network; has a major voice in planning systems and their deployment. Is a driving force behind the fiber optics and communications satellite development programs. Purchases foreign equipment and technology through trading corporations. []

Ministry of Petroleum Industry (MPI). Plans communications systems to support offshore and onshore oilfield operations and pipeline maintenance. Purchases foreign equipment. []

Ministry of Water Resources and Electric Power (MWREP). Plans to expand its present systems to support power grid management. Procures foreign equipment. []

Ministry of Railways. Maintains an independent communications network; manufactures some telecommunications equipment; procures foreign equipment. []

Ministry of Coal Industry (MCI). Seeks communications support for mining in remote areas; has negotiated for foreign equipment. []

Central Meteorological Bureau. Exploring with MPT the feasibility of a network for meteorological communications. []

profusion of actors complicates planning, obscures priorities, creates competition for funding, and hinders the technology acquisition process. []

The Procurement Process

The involvement of numerous and often-competing Chinese organizations seriously complicates the acquisition of foreign equipment and technology. Users of foreign equipment are more interested in having an enhanced capability available as soon as possible and frequently place a higher priority on equipment purchases than the Ministry of Electronics Industry or the MPT, which are most interested in technology acquisition in order to develop domestic production capabilities. The various bureaucracies also are often unable to agree on technical requirements or on their respective roles in a project. Lack of coordination between organizations interested in similar equipment or technology wastes resources and leads to problems of equipment compatibility. []

These problems affect development of both the common carrier network and the specialized networks. China gave up its attempts to procure a combination broadcast and communications satellite from the West in 1980 in part because the several Chinese ministries involved were unable to agree on technical specifications, control of ground stations, or the respective roles of foreign and indigenous technologies.

Funding

Funding affects not only China's acquisition of foreign equipment and technology but telecommunications modernization in general. Management and use of funds at times can be more of a problem than the availability of funds. China's plans will require considerable investment of both domestic funds and foreign exchange. The MPI satellite program and

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related ground systems are expected to cost at least \$140 million and the direct broadcast satellites another \$200 million. In October 1984 the Minister of Posts and Telecommunications said China would spend \$3.7 billion modernizing telecommunications over the next six years. [REDACTED]

China's actual investment in telecommunications in recent years is difficult to determine because budget figures cited by Chinese officials are often confusing and contradictory. Nonetheless, the relative share of investment in the sector apparently is increasing. [REDACTED]

We believe that telecommunications investment may fall short of the goals. MPT officials expect two-thirds of the \$3.7 billion total investment in the sector under the Seventh Five-Year Plan (1986-90) to come from provincial and local authorities. Although China has considerable foreign reserves available at the national level, local governments in the past have been reluctant to invest in communications, preferring instead investment in revenue-producing sectors such as industry. Even high-priority projects have experienced funding problems. [REDACTED]

Planning and Management Weaknesses

China will continue to face the same planning and management problems that have hindered implementation and operation of telecommunications projects in the past. In some cases, the MPT has ordered equipment that was inappropriate for the intended use. In another case, responsible officials forgot to order all the supplies necessary to complete installation of a new system. [REDACTED]

Many of these problems result at least in part from an inadequate number of experienced, skilled telecommunications managers and technicians in China. Beijing is trying to increase its pool of trained personnel by sending workers abroad for training and by Chinese participation in international meetings. The MPT similarly is trying to streamline management practices to promote greater efficiency. These measures will help Beijing overcome its shortcomings in planning and management, but improvements will take time and continuing difficulties can be expected. [REDACTED]

Implications

Chinese Telecommunications

As a result of the problems facing Chinese efforts to modernize telecommunications, we believe that progress will be slower than China expects, even for priority projects such as communications support for energy development and improvement of telephone and data communications services in key cities. One exception will probably be the development of a fiber optics network, which is not only a high-priority project but which has the weight of a centralized planning and development effort—with military oversight—behind it. [REDACTED]

Despite the infusion of new equipment and technology and slowly improving management skills, we believe limited services and inefficient operation will continue for the near future. Progress in improving indigenous production capabilities will occur in the long run through technology transfer and joint-venture arrangements. Traditional and intractable Chinese problems in absorbing advanced foreign technology, however, will slow the rate of progress. [REDACTED]

Some improvements notwithstanding, in our view, China's communications services will continue to be inadequate to support China's economic modernization. Problems in communications will continue to

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affect common business needs such as coordinating plans, ordering supplies, transferring funds, tracking shipments, and making travel arrangements. Plans to increase educational levels in China through expansion of educational broadcasting services have already been delayed by lengthy negotiations over the purchase of direct broadcast satellites and related technology. Limited communications services to outlying provinces will continue to hamper the development—both economic and social—of those regions. [redacted]

Development of Electronic Component and Computer Industries

Improvements in Chinese telecommunications contribute to a related priority need for China: advancing the capabilities of China's electronic component and computer industries. Telecommunications and the computer industry have become increasingly interrelated, with both dependent on microelectronics.³ Computers are an integral part of advanced switching systems, while telecommunications links are increasingly used for interactive computer systems and computer networking. The Chinese recognize the importance of building up their electronic component industry and are insisting integrated circuit factories be included in switching deals with French and Dutch firms. The facilities China will receive under the Belgian deal for the manufacture of large-scale integrated circuits represent a quantum jump in China's existing capability to design and produce volume quantities of advanced semiconductor devices. [redacted]

Benefits to the Military

The military will almost certainly be an immediate beneficiary of improved telecommunications capabilities in China. [redacted]

[redacted] In times of emergency or disaster, the army takes complete charge of all communications. The MPT has used military circuits when civilian communications were disrupted, and military communications are commonly noted on civilian channels. [redacted]

[redacted]

The military is intimately involved in two of China's highest priority telecommunications projects—the development of a fiber optics system and the development of communications satellites. All research, development, and production activity relating to fiber optics was placed under the unified direction of the National Defense Science Technology and Industry Commission (NDSTIC) in 1979. Chinese telecommunications planners have noted publicly [redacted]

[redacted] that this technology will be used to provide secure communications between military headquarters units, radar ground stations, satellite receiving stations, and in dedicated military command and control networks. [redacted]

Improvements in switching capabilities will probably benefit China's command and control structure. Computer-controlled switching greatly enhances the flexibility required for effective command, control, and communications because the computer can be programed to adapt to changing conditions in real or near-real time. [redacted]

In addition, we believe China will divert the advanced integrated circuit technology acquired as part of the Belgian switching sale from telecommunications development to the prohibited mission areas. In the past, when China has acquired similar technology illegally, it was most often used to support advanced weapons development. It is probable that China will replicate the Belgian-supplied factory in other parts of the PRC, using the original installation as a center upon which to pattern other facilities and to facilitate training. [redacted]

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Export Potential

China hopes eventually to become a major competitor in the international telecommunications market. China claims it markets a full range of telecommunications projects abroad, although such Chinese products are clearly at the low end of the technology scale. China's cooperation with foreign firms is a key element of its strategy to expand the types and amounts of products exported. Many of the joint ventures being formed include provisions for the sale of products on international markets. []

Although we believe China will be unable to offer products which are the technological equivalent of the most advanced US or Japanese products, it may well try to compete with US and other foreign manufacturers for Third World markets. This pattern has been followed by other countries which are not technically competitive with the United States in telecommunications products, but offer adequate products to Third World countries, frequently at attractive prices. []

Significance for the United States

China's plans to modernize its telecommunications systems offer the United States opportunities to contribute to a sector critical to China's economic, social, and military modernization. Beijing seeks US assistance through government as well as private cooperation and technical assistance programs. US firms are negotiating for equipment and technology sales, although they face serious competition in the Chinese market. []

The Chinese telecommunications modernization effort also will probably increase tensions within COCOM and perhaps in US-Chinese relations. The desire to take advantage of sales opportunities in China and to improve relations with China is leading some COCOM members to press for a further relaxation of export controls to that country. At the same time, the role of the military in China's telecommunications systems and the military implications of expanded Chinese production capabilities will continue to make telecommunications assistance—particularly technology sales—to China controversial. For example, the conclusion of a proposed US-Chinese telecommunications protocol is being held up by a Chinese request that fiber optics development be included in the agreement. []

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Appendix A Current Chinese Telecommunications Services and Modernization Goals

The common carrier network operated by the Ministry of Posts and Telecommunications provides domestic and international telephone, data transmission, and broadcast services, primarily for government, military, and industrial users. This public network is supplemented by several special networks dedicated to meeting specific user needs. [redacted]

Telephone Service

The Chinese phone system is heavily used and overworked. Poor service—including long delays in new phone installation, faint or interrupted conversations, and problems in making long-distance calls—is a frequent complaint, as is the insufficient number of phones. Phone service is oriented toward government and business rather than private individuals, although private lines are available to selected ranking military and government officials. [redacted]

In the interior and border regions, telephone services are limited, and overhead landlines are subject to frequent interference from weather and other natural phenomena. Even in major coastal cities where the best services are to be found, severe problems exist. An administrator of Beijing's Telecommunications Administration said in 1983 that Beijing's phone system is overloaded and operating at 30 percent above planned capacity. Shanghai's telephone system also is similarly overtaxed. Since 1949 the geographic area covered by Shanghai's network has increased tenfold, but only 30,000 new phone lines have been added. [redacted]

Most long-distance phone calls require operator assistance. Except for limited direct-dial service between Beijing, Shanghai, Tianjin, Jinan, Hefei, Nanjing, Hangzhou, and Xian, all other long-distance services are at least partly manual. (Direct-distance dialing reportedly is possible to seven cities from Beijing and 12 from Shanghai.) Until recently, all long-distance calls were routed through Beijing. Operator assistance is often needed even on circuits which are supposed to be direct dial. [redacted]

Efforts during the last several years to improve the phone system have been only partially successful. Although the numbers cited to support their claims of improvements vary, MPT officials said China in 1980-82 had installed 270,000 new phones and 5,000 long-distance phone circuits in big and medium cities. The number of international phone calls increased during this period by 300 percent, telex by 500 percent, and international cables by 75 percent. The State Statistical Bureau report on the results of the 1983 plan cited a 9.7-percent increase in the number of urban phone subscribers and a 12.7-percent increase in long-distance phone calls for the year. Nonetheless, the report concluded that development of telecommunications had failed to keep pace with economic development as a whole and strains on the system had not been alleviated. [redacted]

International Communications

Most international communications are provided by satellite and submarine cable links, although some high-frequency radio, open wirelines, and microwave radio relay links also carry international traffic. China uses about 270 satellite communications circuits with over 20 countries from ground stations in Beijing and Shanghai via Intelsat's Pacific and Indian Ocean satellites. A 480-channel submarine cable has linked Japan and China since 1976. [redacted]

[redacted] International Telecommunications Service in Beijing provided direct-dial service between 22 Chinese cities and New York, Hong Kong, and Tokyo in 1980, but many international calls had to be completed manually or with operator assistance because of problems interfacing

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Chinese equipment with Western technology. [redacted]

[redacted] Fujian and Guangzhou Provinces recently upgraded service to Hong Kong, and international commercial communications circuits between Beijing and New York were upgraded in 1982. [redacted]

Data Communications

China's communications systems have very limited data transmission capabilities. Some local communications loops in major cities can handle high-speed data transmissions, but long-distance data communications capabilities are extremely limited and restricted to the most important government and party offices. [redacted]

Problems affecting data transmissions include poor quality domestic equipment, especially bad cables and terminal gear; excessively high noise levels on regular commercial phone lines; and inadequate facilities for time-sharing. [redacted]

[redacted] The Chinese also have experienced difficulties making proper equipment adjustments and suffer from a general lack of technical computer and data transmission experience. [redacted]

A number of data communications projects are stalled because of the lack of adequate telecommunications services:

- A modern computer-based central reservations system for Civil Aviation Administration of China (CAAC) flights. In 1980 CAAC had no choice but to set up its International Flight Reservation Center in Hong Kong because the Chinese telephone system was unable to service CAAC needs. Only recently has CAAC been able to establish a center in Beijing.
- Establishment of the nationwide science and technology information network linking domestic research centers to each other and to foreign information systems. This network, listed as a priority as early as 1977, has experienced multiple delays because data transmission services were inadequate.

- A national economic information system organized by the State Economic Commission (SEC) to receive and analyze economic information from provincial authorities.

- Individual enterprise plans for computer networks, such as a computer network to handle data collection, report generation, and energy load forecasting for the Anshan Steel Company.

- A nationwide digital seismic network for earthquake prediction.

- Dedicated data communications networks for oil and other energy management. [redacted]

Broadcasting

Beijing reports that 64.5 percent of China's population is reached by radiobroadcasts, with TV broadcasts reaching 59.9 percent. Special-purpose microwave lines for radio and TV have increased over the past two to three years and reached 8,000 kilometers in 1983. Video relay stations have extended TV service to outlying Xinjiang and Xizang Provinces. China's experimental communications satellite, launched in April 1984, now allows viewers in such remote areas as Xinjiang to see TV at the same time as viewers in Beijing. [redacted]

The Secretary General of the Ministry of Radio and Television says the present system of 47 regional TV stations and over 1,000 relay stations is inadequate, covering only 50 percent of China's landmass. The Ministry wants a direct broadcast system to extend coverage to at least 80 percent of the population, primarily to make televised educational instruction widely available. [redacted]

Specialized Telecommunications Networks

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A number of industrial users also have their own communications networks using either dedicated lines leased from the MPT or communications networks developed independently. The Ministry of Petroleum Industry, the Ministry of Water Resources and Electric Power (MWREP), and the Ministry of Railways all have separate communications networks, while the Ministries of Coal Industry, of Education, and of Radio and Television have plans to develop their own networks.

More specific goals for telecommunications were spelled out in China's Sixth Five-Year Plan (1981-85). This plan called for installing 700,000 phones, adding 6,200 kilometers of telecommunications cable for long-distance calls, and building 2,700 telephone offices and suboffices. Additional targets under the Plan are discussed below.

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City Telephone Service. China plans to increase this from a total national capacity of 2 million households in 1980 to 2.7 million households in 1985. Service in 12 selected cities is to increase 80 to 100 percent over the five years of the plan. (Longer term MPT plans call for 1.5 phones per 100 people nationwide and 20 phones per 100 people in major cities by 2000.)

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Domestic Long-Distance Service. This is to be improved by increasing the capacity of trunklines, replacing open-wire trunklines by cable, and improving microwave trunklines. To be added are 6,000 long-distance circuits and 5,000 additional sets of automatic exchange equipment. According to the Plan, phone users by the end of 1985 will be able to call from Beijing to all provincial capitals, between provincial capitals, and from provincial capitals to selected prefectures and municipalities.

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Modernization Goals

National and local MPT officials have announced plans for modernizing China's common carrier network. A number of industrial ministries also have plans for establishing or expanding dedicated networks.

The MPT

The MPT's general goal for Chinese communications, outlined in a 10-year plan drawn up in 1981, is to increase the pace of development in the telecommunications sector to catch up with and then exceed the rate of development in other sectors. The 10-year plan called for improving the capacity of the telecommunications system as a whole, improving the capacity of long-distance telecommunications, expanding the telecommunications network within the provinces, alleviating the shortage of phones in cities, and establishing a telecommunications and broadcasting satellite system.

International Communications. Facilities are to be upgraded or established in Beijing and Shanghai, followed by Guangzhou and other key cities open for international contacts (such as Tianjin, Fuzhou, Dalian, Qingdao, and Xiamen). A new international communications center in Beijing, begun in December 1983 and scheduled for completion in 1987, is intended to have modern facilities for 2,000 telephone channels, 1,200 telex channels, and 4,000 domestic trunk-call channels. When completed, the center reportedly will allow people in Beijing to call any place in the world through direct dial. Additional international satellite communications channels will be leased.

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Chinese officials indicate that the Seventh Five-Year Plan (1986-90), now being drafted, will continue to emphasize telecommunications development.

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Efforts to improve communications services are under way at the local level as well. Guangdong Province's Sixth Five-Year Plan for 1981-85 calls for 80,000 local telephone lines to be added in Guangzhou and the special economic zones (SEZs) (Shenzhen, Zhuhai, and Shantou); additional long-distance lines to link Guangzhou and Beijing, and several microwave links to be established between the SEZs and Hong Kong. Municipal officials in Beijing are trying to increase the number of city phones from 120,000 in 1984 to 240,000 in 1988, and 500,000 by the end of 1994.

Domestic Satellite Plans *

The Chinese are particularly interested in satellite communications to facilitate government and party communications with border regions, as well as to enhance industrial, educational, and military contacts. Satellite communications in support of offshore oil and gas exploration are a high priority, as is development of a direct broadcast system for educational purposes. Satellite communications are intended to overcome problems caused by distance, terrain, weather, and limitations of existing transmission methods and will offer wider coverage, higher quality, and greater reliability.

The domestic satellite communications system ultimately is to provide telephone, telegraph, data, facsimile, television, and radiobroadcast services to the most remote areas of China by the year 2000. According to plans announced in the Chinese press, it will consist of a network of regional, provincial, and county ground stations. Main regional centers will be directly interlinked; and provincial, prefectural, and county centers will form regional networks using medium- and low-capacity satellite ground stations.

Beijing's immediate plans for establishing a domestic communications satellite system consist of a three-pronged approach: leasing satellite communications channels from the International Telecommunications Satellite Organization (Intelsat), buying a direct broadcast satellite (DBS), and developing an indigenously produced communications satellite system.

The military and military-related organizations are major participants in China's effort to develop a domestic communications satellite system, despite China's claim that the communications satellite system is strictly civilian. After the successful launch of the experimental communications satellite in April 1984, high-ranking officials commended the "PLA commanders and fighters who took part in the development and testing of the satellite." Defense Minister Zhang Aiping listed the NDSTIC, the Signal Department of the Headquarters of the General Staff Department (GSD) of the PLA, and the Ministry of Astronautics Industries (MOAI) as participants in the project. Much of the satellite R&D was carried out by the Chinese Academy of Space Technology, an MOAI subordinate. Other research institutes related to the national defense industries also contributed to the effort. The MOAI, which has overall responsibility for China's missile and space program, owns the launch vehicles and provides launch services, while the launchsites are controlled by the military. The NDSTIC apparently approves and monitors ground station construction.

GSD Telecommunications officials expressed an interest in satellite communications in 1982. No timetable for a military satellite was mentioned, although they said the civilian satellite would be launched first.

The China Electronic Systems Engineering Corporation, which is subordinate to the GSD, was discussing with foreign firms in October 1984 its interest in acquiring satellite technology.

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Goals for Industrial Users

The specialized networks of the industrial ministries focus on telecommunications support for Chinese economic development. [REDACTED]

Ministry of Petroleum Industry. The Ministry of Petroleum Industry (MPI) is developing a major communications system to support oil exploration and development, particularly offshore. Most of the MPI's telecommunications activity focuses on plans for the communications system for oil activity in the South China Sea. The MPI particularly wants to process seismic and other data from offshore production sites into digital data for transmission to onshore sites for relay to Beijing. The offshore system will consist of a satellite communications network for transmission from ship and drilling platforms to onshore communications centers for relay to Beijing and a high-frequency network for use by helicopters and supply boats. [REDACTED]

To complete the communications infrastructure for the petroleum industry, the MPI also plans to link all oilfield and pipeline control centers into the network. Oilfield operations in provinces are now supported by combinations of microwave, cable, and open-wire communications systems. The MPI is constructing new microwave systems to provide communications support to oil development sites in Henan, Shangdong, and Xinjiang Provinces. [REDACTED]

Ministry of Water Resources and Electric Power. In the 1970s, electric power industry investment focused on increasing power generation capabilities, and few resources were allotted for establishing a communications network. Ministry officials acknowledged in 1980 that lack of communications capability had contributed to occasional power blackouts. Additional telecommunications links between power installations, provincial capitals, regional power centers, and ministry headquarters in Beijing are now under development. Tying the six regional power grids into one network is a high priority. [REDACTED]

The MWREP plans initially to use Intelsat channels, then to switch to the domestic communications satellite network when it becomes available. The Ministry already is a user of the experimental communications satellite. The Ministry is developing a satellite system to link Beijing with regional centers for transmission of administrative traffic and load dispatching information. MWREP has two small Earth stations—in Beijing and Chengdu—purchased from a US supplier in 1980. [REDACTED]

The MWREP is also making extensive use of microwave communications. A Beijing-Wuhan microwave line, imported from Japan and completed in 1982, was China's first pulse code-modulated digital microwave communications line. Plans call for extending the line to connect the power networks of east, northwest, and southwest China into a telecommunications loop. The electric power ministry has also been extending its microwave network to newly expanded power plants to provide individual plants with the real-time service and administrative communications necessary to monitor and report on power consumption and maintenance. The MPT has expressed interest in joint use of some of the MWREP microwave network, but MWREP continues to insist that the lines are not suitable for MPT communications. [REDACTED]

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Ministry of Railways. China's need for more effective transportation makes improvement of telecommunications for the railroad ministry the highest specialized telecommunications priority after energy. Lack of adequate communications services hinders the Ministry's coordination of cargo shipments and ticket reservations and its control over the movement of rolling stock. Systems of reliable communications between driver, station master, and dispatcher and between driver, train master, and station master are particularly needed. The railway ministry's telecommunications system is separate from the MPT, with phone lines parallel to railroad lines. [REDACTED]

[REDACTED]
although the ministry manufactures some communications instruments, it is seeking foreign telecommunications equipment. The China Railway Telecommunications and Signaling Corporation (subordinate to the MOR) reportedly has three factories making telecommunications hardware, and two manufacturing cable. [REDACTED]

[REDACTED] optical fibers and high-frequency millimeter-wave communications also were being developed by the ministry. [REDACTED]

Other Dedicated Networks. Ministry of Coal (MCI) officials also want a communications network independent of the MPT. MCI officials in early 1981 expressed interest in sophisticated electronic switching systems, modern transmission systems, and advanced private branch exchanges. [REDACTED]

Press reports indicate MCI also would like to use the Intelsat system for communications with remote mining areas. The Pingshuo open pit mine complex in Shanxi Province is the first priority. Although negotiations for a joint venture to develop the site are not complete, the US partner in developing the site has submitted a proposal to provide small ground stations for the site. China may also consider transportable Earth stations in other areas where mines are clustered. [REDACTED]

The Central Meteorological Bureau is working with the MEI to explore the feasibility of a VHF communications network providing teletype, telegraph, telephone, facsimile, and long-distance data transmission for meteorological communications. One link was in operation by March 1982. [REDACTED]

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Appendix B

Chinese Telecommunications Capabilities and Needs

Switching

The establishment of a modern, high-speed, high-capacity switching capability is essential for expanding and upgrading China's telecommunications services. The Chinese are trying to upgrade exchanges throughout China, but are concentrating their foreign technology acquisition efforts on high-speed electronic switching systems for major urban and long-haul switching needs. []

For a number of years the Chinese have been slowly upgrading their switching equipment from manual systems to the "automatic" electromechanical step-by-step switches and the more sophisticated (but still electromechanical) crossbar switch. Larger cities began getting automatic systems in the early 1970s, mainly to connect government and party offices, and, by early 1981, major Chinese cities and their suburbs had such systems. Only a few major cities have recently acquired advanced electronic systems while most rural switching remains manual. In 1983, municipal telephone switches were said to be 35 percent manual, 32 percent step by step, 24 percent crossbar, 6 percent semielectronic, and 3 percent rotary. []

Most of China's switching equipment, thus, is old or based on outdated technology. Much of the switching equipment in use in Shanghai, for example, was purchased from ITT in 1929; indigenous crossbar switches recently installed in the municipality are based on technology in use in the United States 20 to 25 years ago. Domestic production of both step-by-step and crossbar systems initially was based on foreign technology. []

Domestic production capabilities for switching gear are limited to electromechanical systems and some electronic controls, although several research institutes have begun work on the development of more advanced digital switches. Most manufacture of step-by-step switching apparently ceased in the late 1970s as China committed its resources to production of

crossbar exchanges. []

In going abroad to meet its switching needs, China is looking for advanced electronic switching capabilities, particularly to connect digital transmission and pulse code modulation (PCM) systems and utilize stored program control (SPC). China hopes to follow the worldwide trend of replacing analog transmission systems with digital systems using PCM. Digital systems are less sensitive to noise, allow signals to be transmitted over longer distances between repeaters, offer increased transmission capacity and more efficient channel use, and offer greater communications security and flexibility, which is particularly useful for military users. Stored program or computer-controlled switches offer flexibility in operation, real-time adaptability to changing telephone traffic conditions, and ease of switch upgrade. []

China has purchased a number of central office switches for the common user network in cities and has been actively seeking production technology. The first major digital switching purchase, a 10,000-line Japanese system installed in Fuzhou during 1981-82, was followed by other purchases of advanced switching systems for Beijing, Shanghai, Tianjing, Xiamen, and Guangzhou. A number of private branch exchanges, frequently for hotels in major tourist locations, also have been purchased. Switches are the most costly element of a communications network, and China wants to develop a domestic capability for the production of high-speed switching. []

Potential Chinese switching capabilities for both the near and longer term were significantly enhanced with the signing of a major agreement with a Belgian subsidiary of a US firm in July 1983. The agreement

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involved the purchase of 100,000 lines of BTM 1240 switching (32,000 for Shanghai and the remainder for Beijing) and the establishment of a joint venture in Shanghai to manufacture the state-of-the-art digital SPC system. Annual production of the joint venture, which includes the transfer of integrated circuit know-how as well as other supporting technology, is expected to be 300,000 lines a year. COCOM approval requires the agreement to be carried out in two phases. Zhu Gaofeng, a vice minister for telecommunications, said the deal would increase Beijing's communications capacity by 20 percent and Shanghai's by 30 percent. [REDACTED]

China is also seeking an additional 100,000 lines of switching, to be supplied in 10 switches, for Beijing. Although a number of firms responded to the Chinese tender, negotiations with the French appear to be the most advanced. The Ministry of Electronics agreed to purchase E10 telephone switching transit centers, to be modified to meet Chinese specifications, and has asked the French to provide China with five factories for the production of integrated circuits and other components necessary for manufacturing the system. The Chinese would like the factories operational within three years, but it will probably take between four and five years to build the facilities, install equipment, and train personnel. The number of lines of switching capacity, the number of factories, and specific technologies to be included have been under negotiation throughout 1984. The French supplier has been unwilling to agree to Chinese demands that it supply US microprocessor technology and a large number of technicians to support the technology transfer. [REDACTED]

Another Chinese priority is acquiring an additional 20,000 lines of switching capacity for Shanghai. This tender in particular is being aggressively sought by foreign firms. Shanghai officials reportedly have said they will only choose one other foreign supplier (in addition to Belgium) for the municipality. Network transmission was adversely affected in the 1960s and 1970s by the introduction of mismatched equipment whose specifications were not uniform. The need to minimize the number of foreign suppliers in order to avoid compatibility problems is a consideration for telephone planners in other Chinese cities as well. [REDACTED]

Japanese firms are so concerned about this sale that they have formed a consortium to offer their newly developed, state-of-the-art digital switch, the D-70, to China—the first known attempt to sell this switch to a foreign customer. [REDACTED]

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In addition to purchasing switching systems which incorporate pulse code modulation devices, China has been trying to acquire ITT PCM production technology for several years. China first bought PCM equipment from Japan and East Germany in the mid-1970s. Successful trial manufacture by the Chinese of PCM communications equipment was noted in 1979, and manufacture of 120-channel PCM equipment by at least one factory began that same year. The ITT PCM equipment, however, is more effective and less expensive than Chinese-made equipment. The ITT PCM costs about \$10,000 per unit, while the domestically produced model, of lower quality, costs about \$40,000 per unit. [REDACTED]

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The State Council in 1983 reportedly agreed in principle to Guangdong's proposal that, if this joint venture were formed, import permits for PCM devices by other foreign suppliers would no longer be issued. The State Council took this measure to ensure that the upgrading of China's telephone network is carried out in a uniform and systematic manner. [REDACTED]

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China is upgrading its switching systems by installing equipment embodying older technology. Even some priority areas will continue to receive crossbar equipment—Tianjin installed a Chinese-made 10,000-line crossbar exchange in May 1984. China has purchased used crossbar equipment from Japan and expressed interest in purchasing crossbar equipment from Singapore. The crossbar, and even the step-by-step exchanges, now in service will continue to be the backbone of the national system. Step-by-step equipment will be used to improve service in remote areas. When systems are upgraded, the existing step-by-step equipment is carefully removed and sent to another location for further use. [REDACTED]

Although most of the emphasis is on switching for telephone and data communications, China also is interested in automatic switching equipment for international telex. China has purchased telex switching equipment from Japan and West Germany and is negotiating additional imports. China has also purchased a large number of teleprinters from Western suppliers. China reportedly successfully tested its first domestically manufactured automatic telex switching equipment in May 1983. [REDACTED]

Fiber Optics

China plans to adopt fiber optics, a highly secure form of wideband communications, to replace terrestrial microwave, which is vulnerable to interception. Fiber optic communications systems transmit light waves along very fine strands of glass or other transparent material. Compared with conventional metallic wire-line systems, fiber optic systems have the advantages of large information capacity, small physical dimensions, immunity to electromagnetic interference, electrical isolation between transmitter and receiver, high reliability, and low equipment and maintenance costs. In addition, the fiber optics medium is less costly than multichannel coaxial cable and is an efficient and reliable substitute for copper which is chronically in short supply in China. [REDACTED]

Over the past five years China has been systematically studying fiber optics technology—optical fiber, cable, light sources, detectors, connectors, splicers, and test equipment—in order to achieve in the laboratory what advanced countries are introducing into production. China has made substantial progress in nearly every area of the fiber optics research and development spectrum. [REDACTED]

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China has installed or has under construction approximately 200 km of fiber optics links, including more than 20 short-haul optical fiber communications systems installed in at least a dozen cities since 1979. Most of the systems were initially set up for test operation. An increasing number of these intracity broadband links have been placed into operational service. Most of these vary in length from 5 to 10 km. Cables installed in Beijing and Wuhan, however, include links that are about 12 and 13 km long, respectively, and there is a possibility that a 100-km line has been installed between Beijing and Tianjin. [REDACTED]

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China intends to import massive quantities of fiber optics technology and manufacturing equipment in order to increase indigenous production rapidly and has approached nearly every major producer of fiber optics equipment as a potential supplier. China is seeking Western sensor technology, fiber optic submarine cable technology, advanced optical tubing manufacturing technology, technology and manufacturing know-how to produce fiber optics communications transmission devices in volume quantities, and is negotiating for several complete production lines for manufacturing light emitting diodes (LEDs) [REDACTED]

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Secret**Satellite Communications Technology**

Although China has had an ongoing program of satellite R&D for many years, lack of success combined with pressing timetables for improving communications is causing the Chinese to look abroad for certain equipment and technology. China appears satisfied with its indigenous capabilities for developing communications satellites, although some reporting indicates time pressures may be causing some Chinese officials to consider purchasing a second-generation communications satellite or components from foreign manufacturers. China has mounted a major effort to purchase direct broadcast satellites and related technology. China also is looking for selected ground station equipment and technology.

Communications Satellites

In April 1984 China launched its first successful communications satellite, designated STW-1. A previous attempt to launch a communications satellite in January failed to reach geosynchronous orbit. The Chinese claim the STW-1 is an experimental satellite, although responsible officials recently said the satellite may be used for operational purposes if tests now under way prove successful. China originally planned an experimental system with two satellites, but recent statements indicate China does not have another communications satellite.

STW-1 is a significant accomplishment for the Chinese, but evidence indicates the satellite has limited capabilities by Western standards and is experiencing operational problems. STW-1 is spin stabilized, has three transponders, and a lifetime of three to five years. By comparison, most Western domestic communications satellites have 24 transponders (and may soon have as many as 40) and last eight to nine years. The Chinese historically have had trouble with power supplies for satellites, which has limited the lifetimes of their satellites.

We believe the satellite may include foreign components despite Chinese claims of being entirely domestically produced. In addition, the Chinese probably acquired some of the technology when they actively sought assistance from several nations in the

late 1970s and early 1980s. Chinese satellite development efforts also were troubled in the past by lack of adequate test equipment and inadequate computers for satellite development and tracking.

Direct Broadcast Satellites

The time needed to develop and produce a direct broadcast satellite, coupled with the stated desire for an operating satellite as soon as possible, has led the Chinese to seek a foreign supplier for broadcast satellites and related technology. In a 1980 meeting Chinese officials estimated that, because of technical and financial requirements, China would take at least 10 years after a successful communications satellite launch to develop its own direct broadcast satellite. More recently, a vice minister from the Electronics Industry said it would take China three to five years to build a direct broadcast satellite. A direct broadcast satellite is technically more complex, heavier, and can be twice as expensive as a communications satellite to build and launch.

China first negotiated with US firms for the purchase of a combination direct broadcast-communications satellite in 1978-80 as part of the Sino-US understanding on cooperation in space technology. Internal disagreements over the purchase and the high cost of the package (\$200 million) led to cancellation of purchase plans in November 1980.

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Although China claims the satellite is urgently needed to meet educational needs, Beijing's timetable for the purchase has already slipped considerably. In early 1984 Chinese officials expected to sign a contract for the purchase by the end of 1984, but the formal request for proposal (RFP) was issued only in November. Foreign firms had their bids in by December, with a decision expected by March or April 1985.

[REDACTED]
Launch of the satellite, originally planned for 1986-87, has been pushed back to 1988. [REDACTED]

The Ministry of Radio and Television, the stated user of the satellite, is anxious to complete the purchase and have an operational satellite as soon as possible. The MOAI and the Ministry of Aeronautics, on the other hand, would accept a slower development program if Chinese technicians were given access to the foreign technologies. [REDACTED]

US, French, and West German firms are competing for the sale. West German and French firms got an early start in the competition for the sale, with extensive preliminary proposals submitted by November 1983. Chinese delegations visited production facilities in both France and West Germany during February 1984, and a delegation from the West German firm Messerschmidt-Boelkow-Blohm (MBB) visited Beijing for two weeks in April. A US firm, the French firm Matra, and a German consortium led by MBB with US and French participation have submitted bids for the sale. [REDACTED]

CBSC officials told US officials in June that the criteria for choosing a supplier will be price, timing, and technology transfer. The associated technology transfer is crucial to the Chinese plan to manufacture

on their own the next-generation broadcast satellite, needed in the mid-1990s. The Chinese have expressed concern about both US guidelines for the sale of satellite technology to China and possible delays in COCOM. [REDACTED]

Launch Services

A separate RFP will be issued for launch services. China has reserved payload space on both Europe's Ariane launcher and on NASA's shuttle for launch of the two broadcast satellites. [REDACTED]

China wants to launch its own copy of the DBS in the future and is developing a new series of space boosters to do so. A US-designed satellite, which would weigh about 1,300 kilograms, may provide an important advantage to China. A West German satellite of equal capacity would be heavier and more difficult for China to launch. On the other hand, the Chinese launcher is similar to the European Ariane launcher, and China could gain useful experience from launching its broadcast satellite on the Ariane if Ariane-space allowed them access to the launch facility. [REDACTED]

Ground Stations

China has a number of domestically manufactured Earth stations, and some Chinese officials claim they are self-sufficient in Earth station equipment. Chinese officials have said China has a network of more than 30 ground stations, constructed primarily by China, for use with its domestic communications satellite. Other estimates put the number closer to 50. Recent Chinese press releases report additional MEI successes in developing a new 3-meter satellite TV and radiobroadcast receiver meeting international standards. [REDACTED]

China has benefited, however, from foreign-supplied ground station equipment and technology. Three Intelsat ground stations were acquired from the United

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States beginning in 1972; these stations have since been upgraded with the assistance of foreign firms. Japanese firms have also supplied an Earth station and other ground station equipment. Tests of the ground stations using international satellites also have improved Chinese capabilities.

China encountered numerous problems in meeting mandatory Intelsat performance standards in 1982 tests to certify 10 Chinese ground stations for use with Intelsat. Initially, only one of the first group of four stations to undergo verification testing passed, and several extensions of the testing period were required before the remaining stations were verified. Nonetheless, the tests proved the Chinese have 10 stations which are capable of meeting Intelsat requirements.

much of the ground station technology is more than 10 years old. Through good maintenance, the equipment appears to function adequately, although in some cases its reliability may be questionable. Technical shortcomings limit capabilities. Chinese-manufactured equipment suffers drawbacks such as large and outdated electronics and primitive power feeds for antennas. Much of the domestically manufactured equipment is believed to be experimental and would probably be difficult to get into volume production. In negotiation with foreign Earth station manufacturers, the Chinese have sought training in installation techniques and the integration of the antenna with its electronics package, suggesting additional Chinese weaknesses.

China has approached foreign suppliers for assistance not only for the more complex Earth stations needed for Intelsat communications and the domestic communications system, but also for the ground stations needed for the direct broadcast system. Delays in procuring ground station equipment are responsible at least in part for a Chinese decision to delay the effective date of Intelsat leases for satellite communications channels. Spar Aerospace of Canada signed a contract in 1984 to provide a central Earth station for the MPT which will serve as the central station for the entire domestic satellite network, 15 stations for the Ministry of Petroleum Industry satellite system, and 10 (in kit form) for the Ministry of Electronics Industry.

This past summer the Chinese signed another letter of intent to purchase a set of six antennas for radio and TV communications.

Some of these purchases and negotiations undoubtedly reflect the high priority Beijing places on developing an operational system as soon as possible without waiting for domestic production to improve sufficiently. On the other hand, some of these discussions may be efforts to acquire technology.

Cable

Despite plans for the installation of advanced fiber optics systems, China's telecommunications network continues to be expanded and upgraded through the installation of more conventional multiconductor and coaxial cable. Most cable trunklines in coastal areas are buried, but overhead wire and cable strung from

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poles are still the major transmission media. The country is trying to switch to buried cable as quickly as possible. Buried cable offers additional communications security for military as well as government subscribers and decreases interference from natural phenomena. [REDACTED]

Capacity is also being expanded as open-wire lines with up to 12 channels per wire pair are replaced with multiconductor cable of up to 480 channels. China has two major coaxial cable trunklines, one of which was upgraded from 300 to 3,600 channels in 1980-81 with the assistance of the West German firm Siemens. A number of coaxial cable installation projects are under way in coastal provinces. China's first use of 10,800-circuit coaxial cable was noted in March 1984. [REDACTED]

China has looked to foreign suppliers for more advanced production, insulation, jointing, and closure technology. Until recently, China's cable production was based on 20-year-old technology. Insulation is largely paper with lead sheathing, making the system vulnerable to damage from water seepage. (Water damage in Guangzhou, for example, affects 18 percent of the system annually, compared with the 0.5-percent damage suffered annually by US networks.) Splicing is largely the twist and solder method, with some mechanical techniques; installation is accomplished by manual trenching or static plowing techniques. Recent agreements with US suppliers for advanced cable technology have the potential for significantly improving Chinese cable production capabilities. [REDACTED]

Microwave

A microwave radio relay network extends 14,000 to 15,000 km from Beijing to outlying regions, including all provincial capitals except Lhasa and Urumqi. Microwave is used for television broadcasts, relay of Beijing newspapers by facsimile, and some voice communications. Use of the system has been limited, however, by concern that microwave communications may be intercepted. In addition to plans to replace microwave with the more secure fiber optics transmission systems, the Chinese also are seeking encryption equipment to increase the security of microwave transmissions. [REDACTED]

Nonetheless, for some uses and in some areas microwave will continue to be used. The MPT is extending microwave links in the northeast and is gradually upgrading long-distance trunklines. A microwave project linking Guangdong and Hong Kong is a high priority for telecommunications officials in Guangdong. The Ministry of Water Resources and Electric Power (MWREP) intends to use microwave for its electric power grid management and is extending its Beijing-Wuhan microwave line with three new branches. Plans also call for microwave uplinks for both the domestic satellite program and the MPI's communications systems. [REDACTED]

China lags behind the West in microwave communications systems. Although some 1,800-channel equipment has been installed recently, most of the existing network is a mix of 960-channel, with some 600-channel, equipment. Most Chinese microwave links operate at frequencies of 4 GHz, while some 2-GHz equipment apparently is used on medium-range trunks and for the electric power and oilfield communications networks. The Chinese-built equipment suffers from a variety of technical shortcomings, including frequency instability which affects signal transmission characteristics. [REDACTED]

Chinese MPT officials admitted in mid-1982 that China was experiencing technical problems with the development of microwave antennas. Their comments indicated the production technology used is very outdated and that Chinese antennas were not on a par with US antennas produced 10 years ago. [REDACTED]

Actual or planned Chinese purchases of microwave equipment are for high-priority areas such as Guangdong Province or for specialized ministries such as the MWREP or the MPI for energy communications.

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MPT trading corporations and factories are concentrating their efforts on acquiring advanced microwave production technology through joint ventures and on the purchase of needed test equipment. [REDACTED]

Troposcatter

China also is building a UHF/SHF troposcatter communications network, with more than 20 installations already constructed, which may be linked with national landline and radio relay communications systems.⁵ Troposcatter networks could increase China's command and control flexibility. China has developed its own troposcatter equipment, including digital troposcatter equipment, apparently for both military and civilian applications. [REDACTED]

Meteor Burst

The military has expressed an interest in a meteor-burst communications system, which uses reflections from meteor trails for data communications. The China Electronic Systems Engineering Corporation, an arm of the PLA General Staff Department, visited US firms in June 1984 to discuss equipment purchases. Current plans call for a master station and two repeaters in central China and a master station in both the east and west, to be supplemented by up to 300 remote communications stations to provide countrywide coverage. [REDACTED]

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In late 1983, MEI officials predicted a large demand for troposcatter use by the petroleum industry, electric power utilities and hydropower facilities. [REDACTED]

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⁵ Troposcatter networks are cost-effective means of using microwave communications over long distances and rugged terrain because relay stations can be spaced up to 800 km apart, reducing construction and maintenance costs associated with more conventional microwave systems. [REDACTED]

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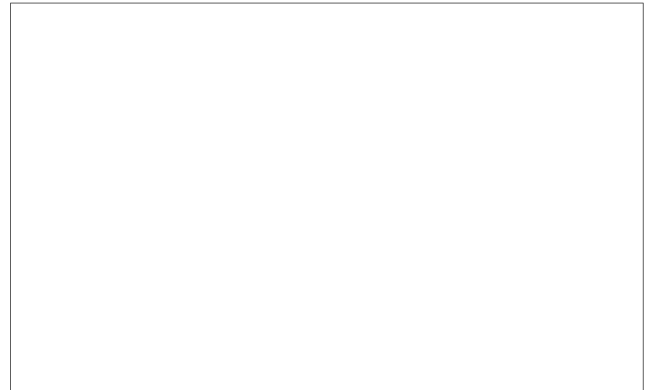
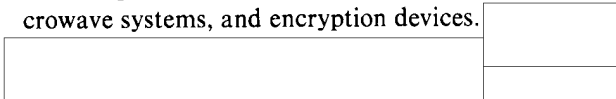
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Appendix C

China's Efforts To Acquire Foreign Equipment and Technology

Equipment Purchases

China already has acquired advanced telecommunications equipment—switching systems, satellite ground stations, and some telecommunications terminal and test equipment—and foreign suppliers are eager to conclude further equipment sales. Beijing, Shanghai, Tianjin, and several other cities have bought advanced digital switches for upgrading their telephone networks, and additional major purchases for Beijing and Shanghai are under negotiation. Numerous hotels and enterprises have acquired private branch exchanges. China bought 26 satellite ground stations from the Canadian firm Spar Aerospace in 1984 for the MPT, MPI, MEI, and PLA. Other purchases include PCM devices, telephone concentrator systems, used crossbar switching equipment, telex switching equipment, microwave systems, and encryption devices.



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Technology Transfer Mechanisms

In addition to foreign purchases, China is using other mechanisms to acquire advanced technical information and upgrade its telecommunications systems, including extensive international cooperation and foreign training for Chinese personnel.

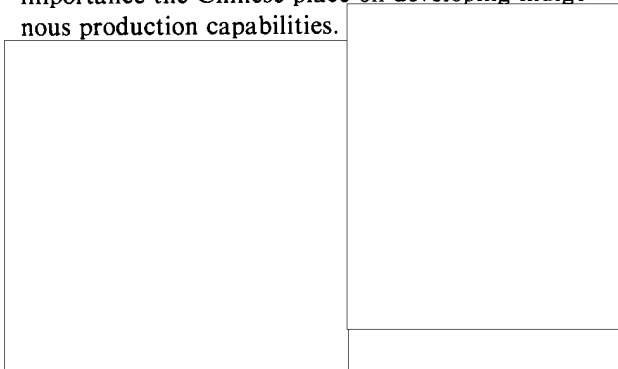
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Emphasis on Production Technology

Direct purchase of telecommunications equipment would allow China to upgrade its services relatively quickly. Nevertheless, the major Chinese effort has been directed increasingly toward the acquisition of production technology. This focus stems from the importance the Chinese place on developing indigenous production capabilities.



Government-to-Government Cooperation

Although China has ongoing or proposed programs for cooperation in telecommunications and space with West Germany, the United States, Italy, France, the United Kingdom, and Brazil, Japan has been most active in extending assistance for China's telecommunications development.

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Japan. The Japanese Government and Japanese firms have been active in the development of China's telecommunications since at least the early 1970s. Recent cooperation includes financial credits, cooperative programs, and equipment sales and training.

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Financing. In March 1984 Prime Minister Nakasone announced a seven-year, 470 billion yen (\$2.1 billion) development credit to be used for Chinese transportation, communications, and energy projects. Although

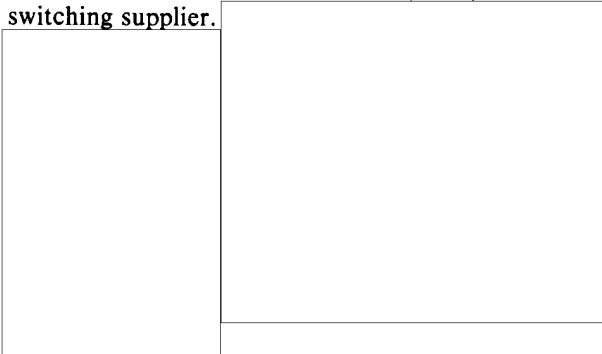
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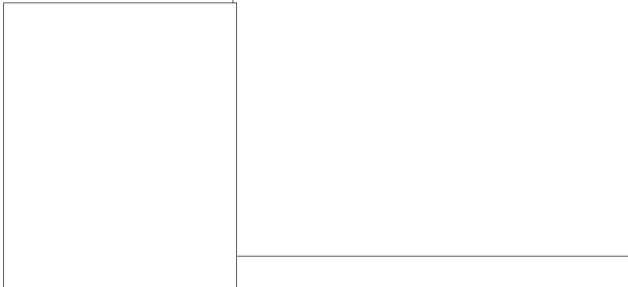
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most of the credit will go for coal projects, approximately \$500,000 is expected to go for communications development in Beijing, Tianjin, Guangzhou, and Shanghai. The aid will be in yen and Japanese firms will be strong competitors for the business the credits will create. Japanese firms have bid on projects in Beijing and Shanghai, while Tianjin already has selected Nippon Electric Company (NEC) for its switching supplier.



Cooperative Programs. A joint consultative group comprising Japanese Government agencies and private firms was established in July 1984 in response to a request by China's MPT. The group will study technical cooperation in the communications and information processing areas. The Japanese telecommunications agency, Nippon Telephone and Telegraph (NTT), signed a memorandum of cooperation with the MPT in 1980, and renewed it in 1982, for promotion of technical exchanges. Additional exchanges covering a variety of telecommunications technologies have taken place.

Equipment Sales.



West Germany. China and West Germany signed a protocol for cooperation in space science and technology in March 1984. The protocol provides for extensive cooperation in communications satellite systems

research, development, and manufacture. Press reports state the two countries also will cooperate in the production and design of telephones, radios, and scientific satellites. The Chinese Minister of Aeronautics visited West German firms before signing the agreement. West Germany and France granted China free use of their jointly owned Symphonie satellite for six months in 1978 and 1979 to allow China to test its Earth satellite stations.

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United States. The United States and China are currently negotiating agreements for cooperation in telecommunications and space. Agreement on the telecommunications protocol has been delayed by Chinese insistence on including fiber optics technology in the areas to be covered under the protocol.

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Italy. China's space technology cooperation agreement with Italy was also signed in March 1984. A Chinese delegation visited an Italian firm after the agreement was signed to discuss cooperation in the production of satellites, sensors, and other equipment.

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France. France and China signed a five-year space cooperation agreement in February 1985 which includes the joint study of a telecommunications network and expert exchanges on prelaunch testing of satellites. Previous Sino-French agreements include cooperation in electronic switching, microwave, and data transmission. In November 1984 the Chinese Ministry of Astronautics signed a protocol on technical exchange and cooperation in space industry with the French firm Matra. Chinese Defense Minister Zhang Aiping called the agreement a new start to space cooperation between the two countries.

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Brazil. In August 1984 China signed an agreement with Brazil to cooperate in space research, China's first such agreement with a Third World country. China may be attempting to acquire through Brazil space technology which China cannot obtain directly

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from an advanced country. Brazil has already purchased ground stations and two satellites from Canada. Brazil stands to benefit from China's experience with rockets, guidance, control and tracking technology, and liquid propellant expertise. []

United Kingdom. Britain and China signed a memorandum of understanding on space collaboration in January 1985. The agreement calls for exchanges of scientists and cooperation in the latest satellite technology. []

Overseas Training

In addition to the training included in contracts for imported equipment and technology purchases, Chinese students and engineers have been sent abroad for training at both universities and foreign firms. Chinese telecommunications specialists have done advanced research at US universities, while a large number of Chinese students at US and other foreign universities are studying engineering, electronics, computers, and other telecommunications-related subjects. China has also sent a number of its telecommunications personnel to US firms for training. Training topics under these private exchange programs have included: organization of modern telecommunications networks, planning and operations, rates and tariffs, effective utilization of modern telecommunications equipment, advanced switching technologies, radioelectronics, and microwave and millimeter-wave propagation research. Chinese engineers have been sent to Italy and Japan on similar training exchanges. The Chinese have also hosted visits by foreign engineers to China for seminars on telecommunications topics. []

Participation in ITU Activities

An additional avenue for information exchange and assistance has been increased Chinese involvement in the International Telecommunications Union (ITU). Chinese participation in regularly scheduled ITU conferences and meetings serves as an educational vehicle for Chinese engineers and officials. ITU delegations visiting China have discussed topics such as packet and data switching networks and telecommunications planning. China requested ITU assistance in establishing a pilot system for automatic testing of transmission quality in 1982 and in 1983 jointly hosted with the ITU an International Seminar on Domestic Satellite Communications in Beijing. []

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